Armed Forces College of Medicine

AFCM

Prof. Dr. George F.B.

External features of the spinal cord

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INTENDED LEARNING OBJECTIVES (ILO)

By the end of this lecture, the student will be able to:

1. List the components of the NS, CNS & different derivatives of various parts of the brain.
2. List the beginning, termination, shape, meninges & support of the spinal cord.
3. Describe the technique of lumbar puncture & list its purposes.
4. Compare between the ventral & dorsal roots of the spinal Ns.
5. Compare between exit of spinal Ns. in relation to vertebrae & identify its clinical importance.
6. Differentiate between the ventral & dorsal rami of the spinal Ns.
7. Find the relation between the segments of spinal cord & overlying vertebral column & identify its clinical

Lecture Plan

1. Part 1 (10 min) Introduction to CNS
2. Part 2 (15 min) Beginning, termination, shape & support of spinal cord
3. Part 3 (10 min) Lumbar puncture
4. Part 4 (20 min) Spinal nerves, relation between vertebrae & spinal cord segments
5. Summary (5 min)

Spinal cord

General facts

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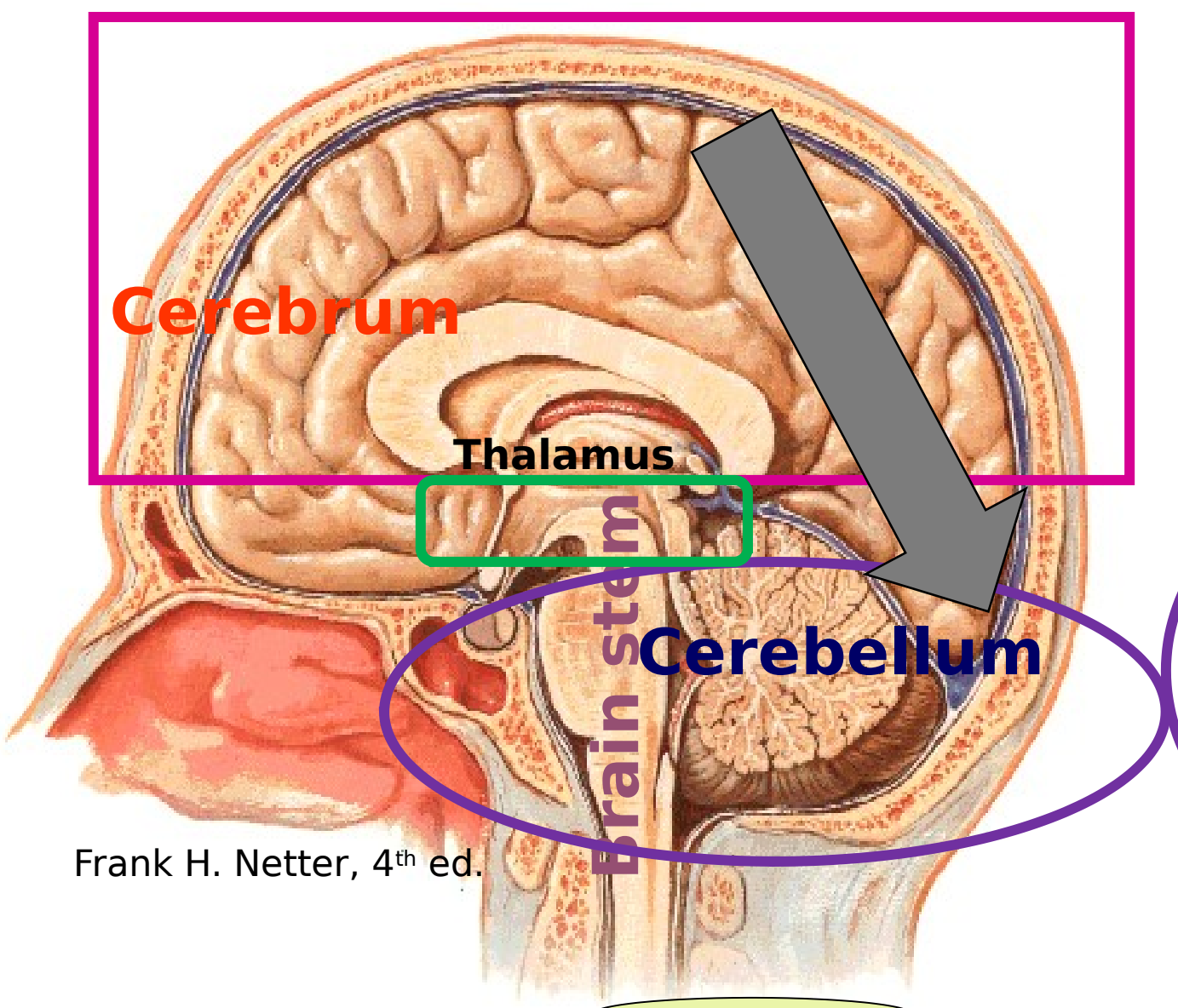
Subdivisions of the Nervous System

- **Central**
  - Brain
  - Spinal cord
- **Peripheral**
  - Somatic
  - Autonomic



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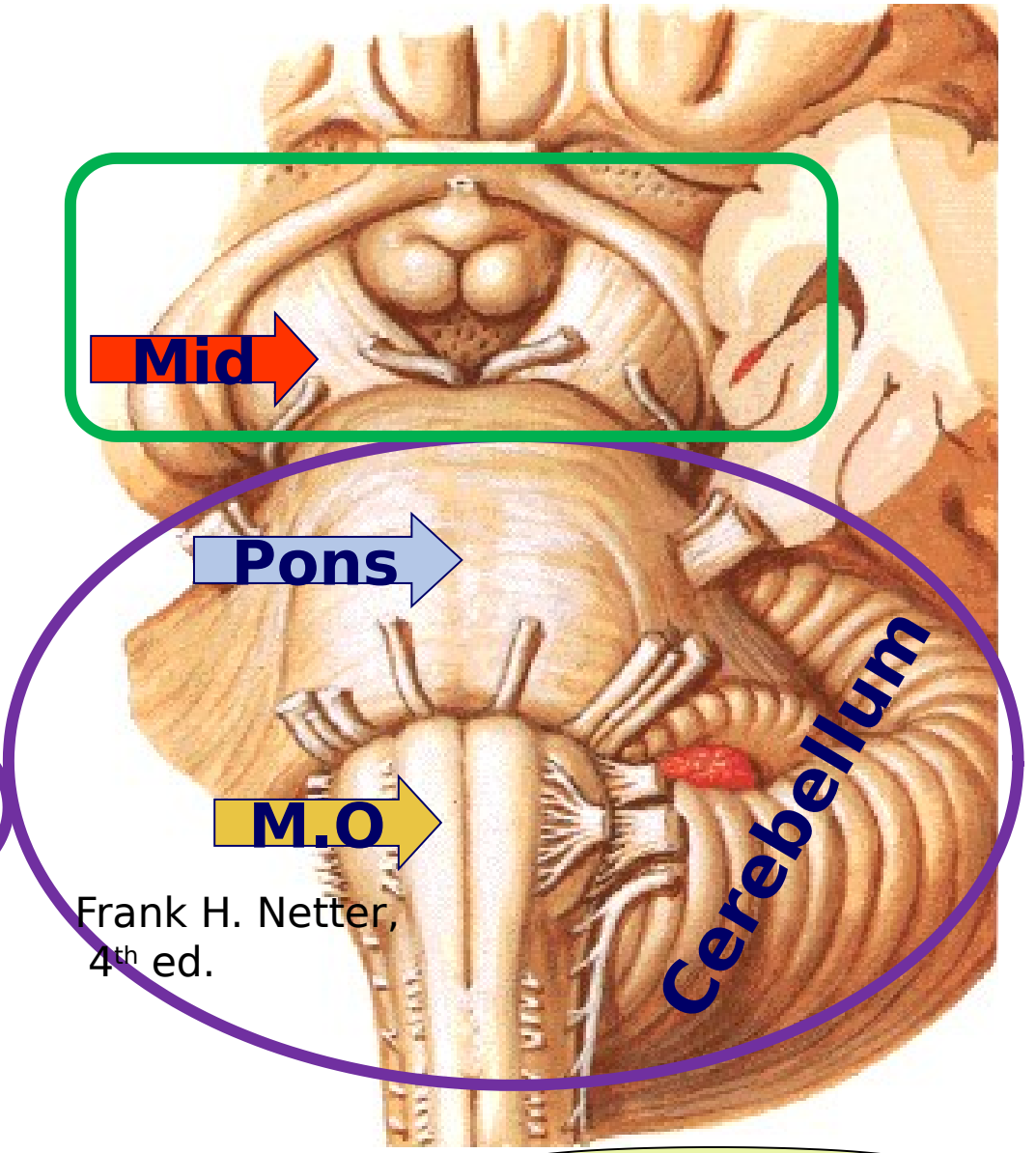
Parts of the brain



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Parts of the brain stem

Developmentally, CNS is divided into 3 major par

1- Forebrain:

a. Cerebrum

b. Thalamus

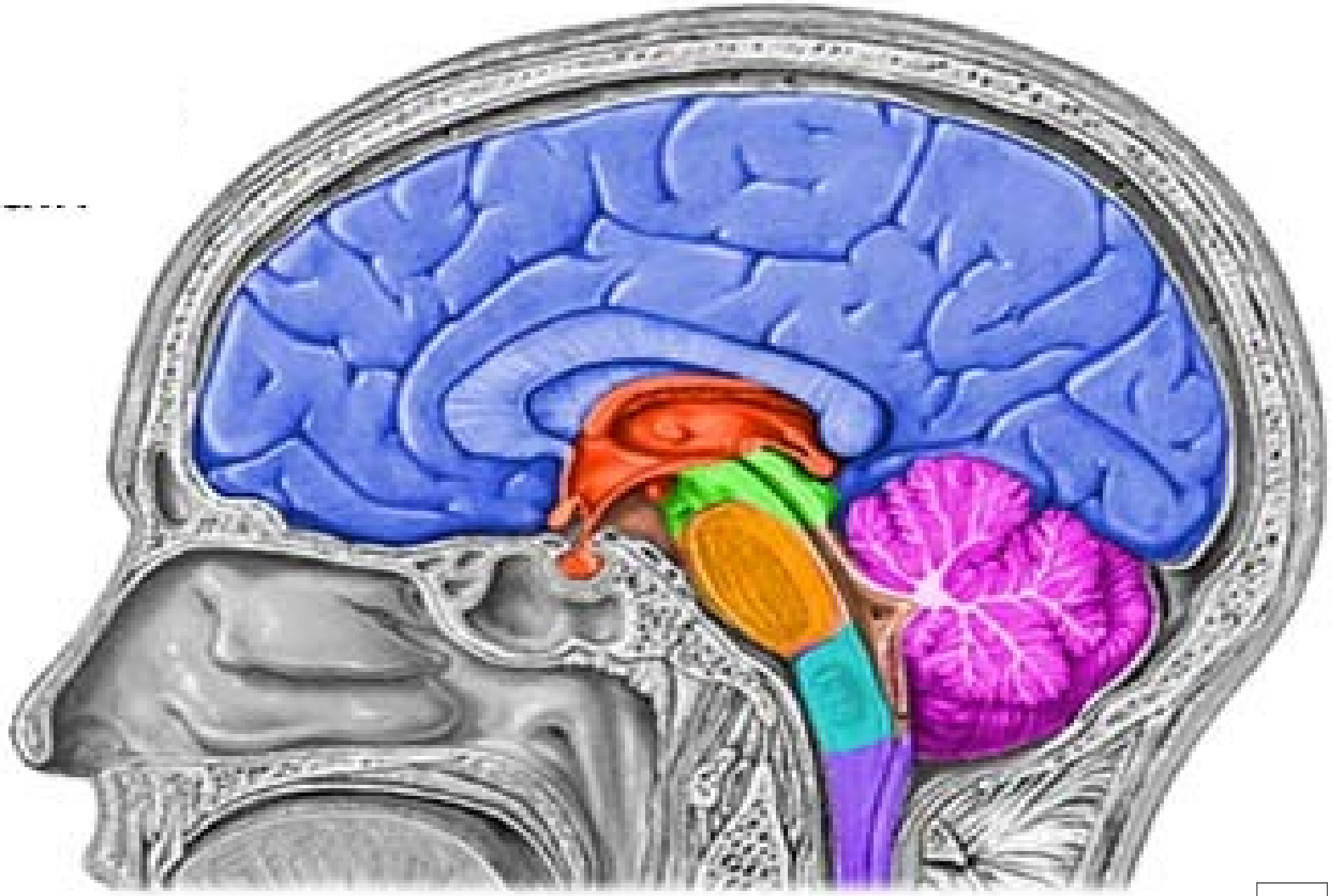
2- Midbrain

3- Hindbrain:

a. Pons.

b. Medulla oblongata.

c. Cerebellum.



Brain

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Fore-

- **Cerebrum (2 hemi-spheres)**
- **Thalamus *et al*. (= dienceph-alon)**

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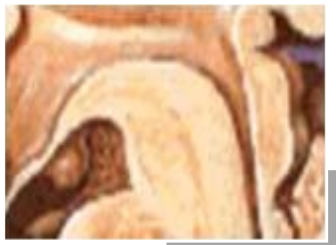

Mid-brain

- **Midbr ain**

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Hind-

- **Pons**
- **Medulla oblongata**
- **Cereb-ellum**

Brain stem = Midbrain + Pons + Medulla oblongata

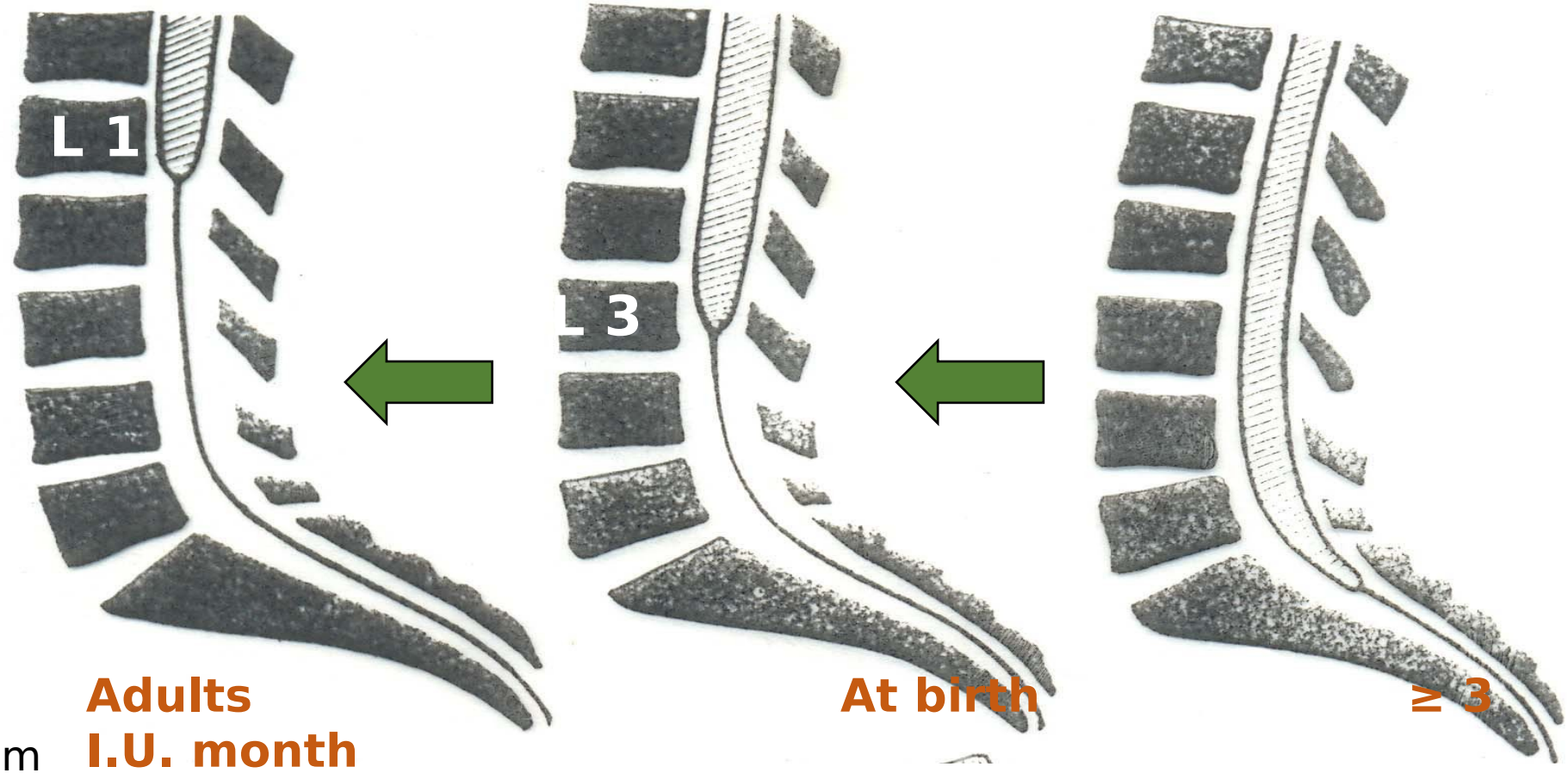
Peripheral Nervous System

Somatic
(Voluntary)

- **12 cranial Ns.**
- **31 spinal Ns.**

Autonomic
(Involuntary)

- **Symp. (Thoraco-lumbar)**
- **Parasymp. (Cranio-sacral)**



- ***Length***: 45 cm
- ***Begins***: at the lower border of foramen magnum (or upper border of C1 vertebra), as the downward continuation of M.O.
- ***Ends***: according to age:

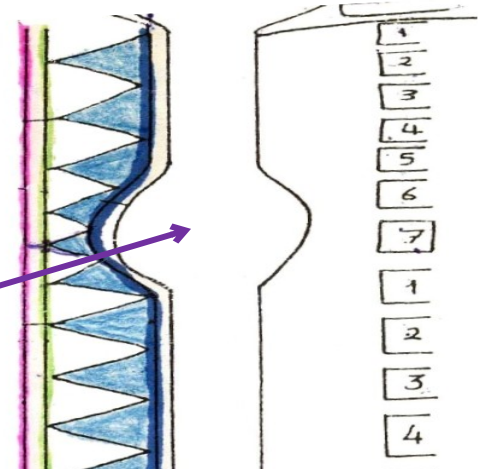
1- Fetus: at the lower end of coccyx.

2- After the 3rd month of intra-uterine life, vertebral column grows faster than spinal cord.

3- At birth, spinal cord ends at L3.

4- In adults, it ends at the lower border of L1

Spinal Cord = Spinal Medulla



- ***Shape:*** Cylinderical except **at 3 sites**:

1- Cervical enlargement (opposite C5-T1 segments

= brachial plexus, to supply the upper limbs).

2- Lumbar enlargement (opposite L1-S4 segments

= L & S plexuses, to supply the lower limbs).

3- Conus medullaris (cone-like lower end)

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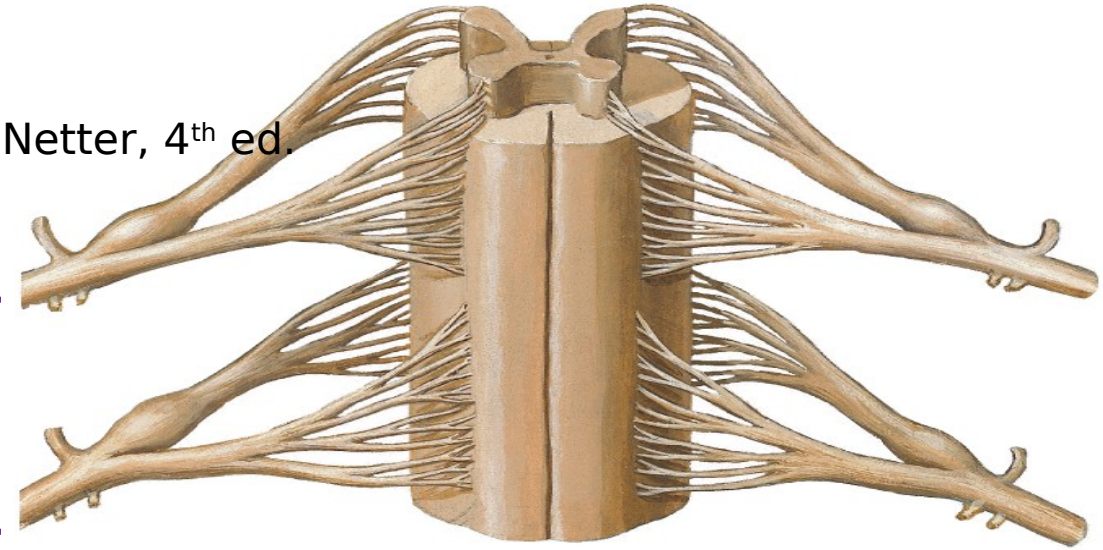

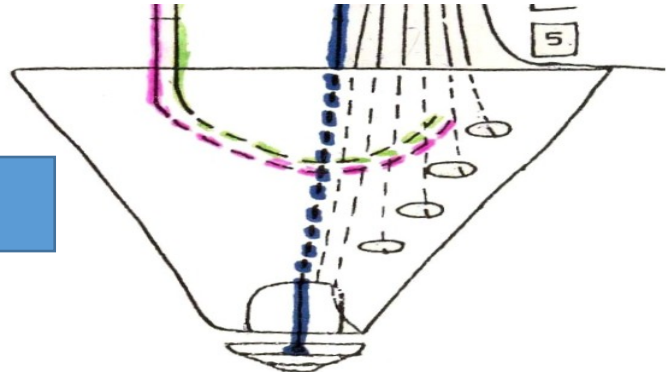

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Hope for the best,
prepare for
the worst
and
expect
nothing.
~ Anonymous

Spinal Cord

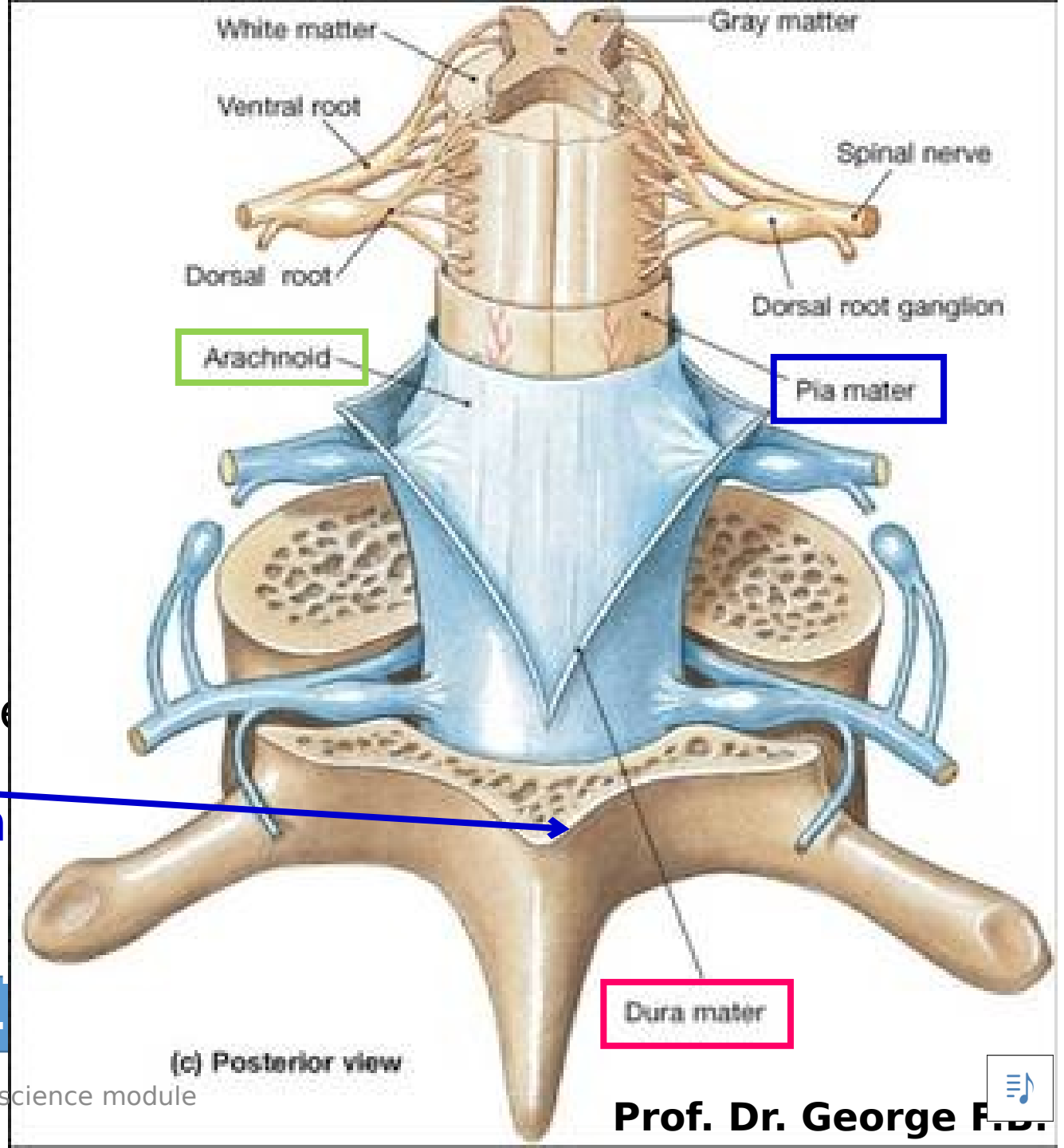
- ***3 Coverings (Meninges):***

1- Outermost (dura)

2- Middle (arachnoid)

Both form a tube that ends opposite S2

3- Innermost (pia) ends at the lower end of spinal cord by forming a thread called **Filum terminale** which passes through sacral hiatus to be attached to Cc1 piece.



Spinal Cord

- ***3 Spaces between the meninges:***

1- Extra-dural (Epidural) space:

Outside the dura; contains fat, small VANL.

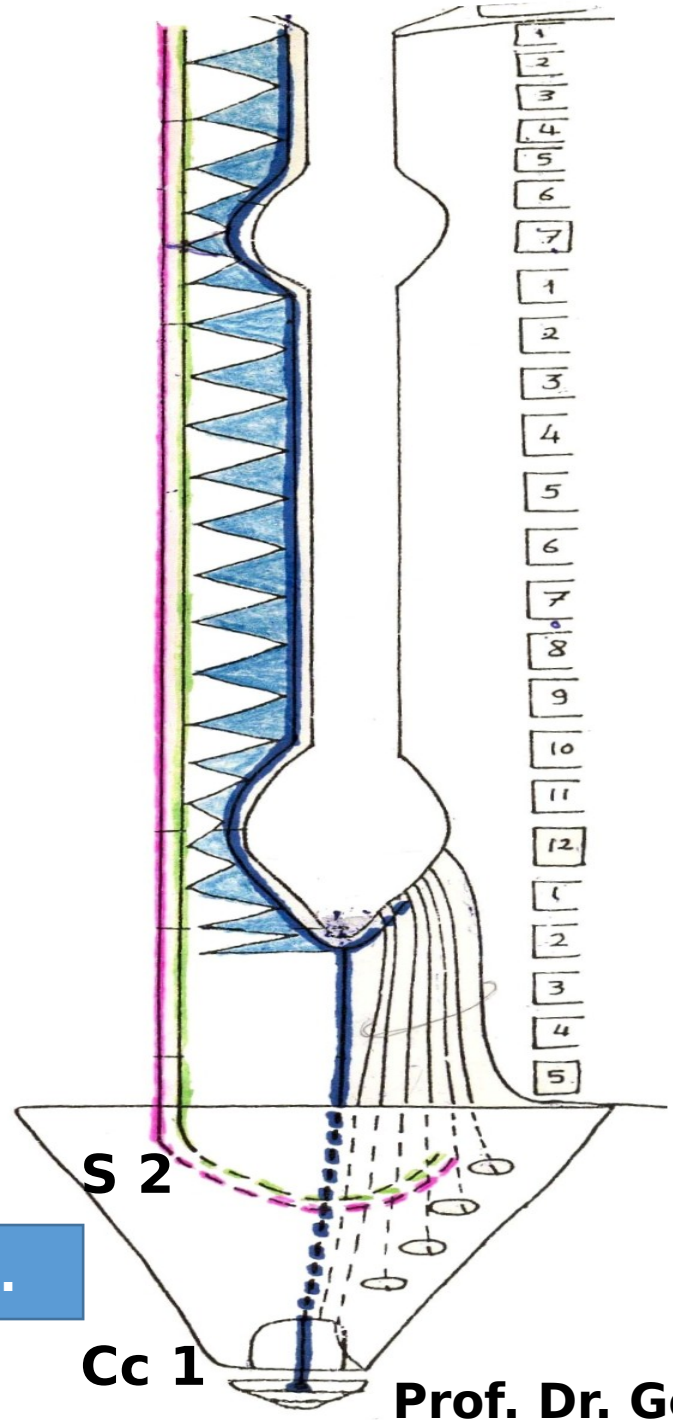
2- Sub-dural space:

Bet. Dura & arachnoid; contains a thin film of fluid.

3- Sub-arachnoid space:

Bet. Arachnoid & pia; contains **CSF**

+ 3 supporting ligs



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Spinal Cord

- ***Support of the spinal cord:***

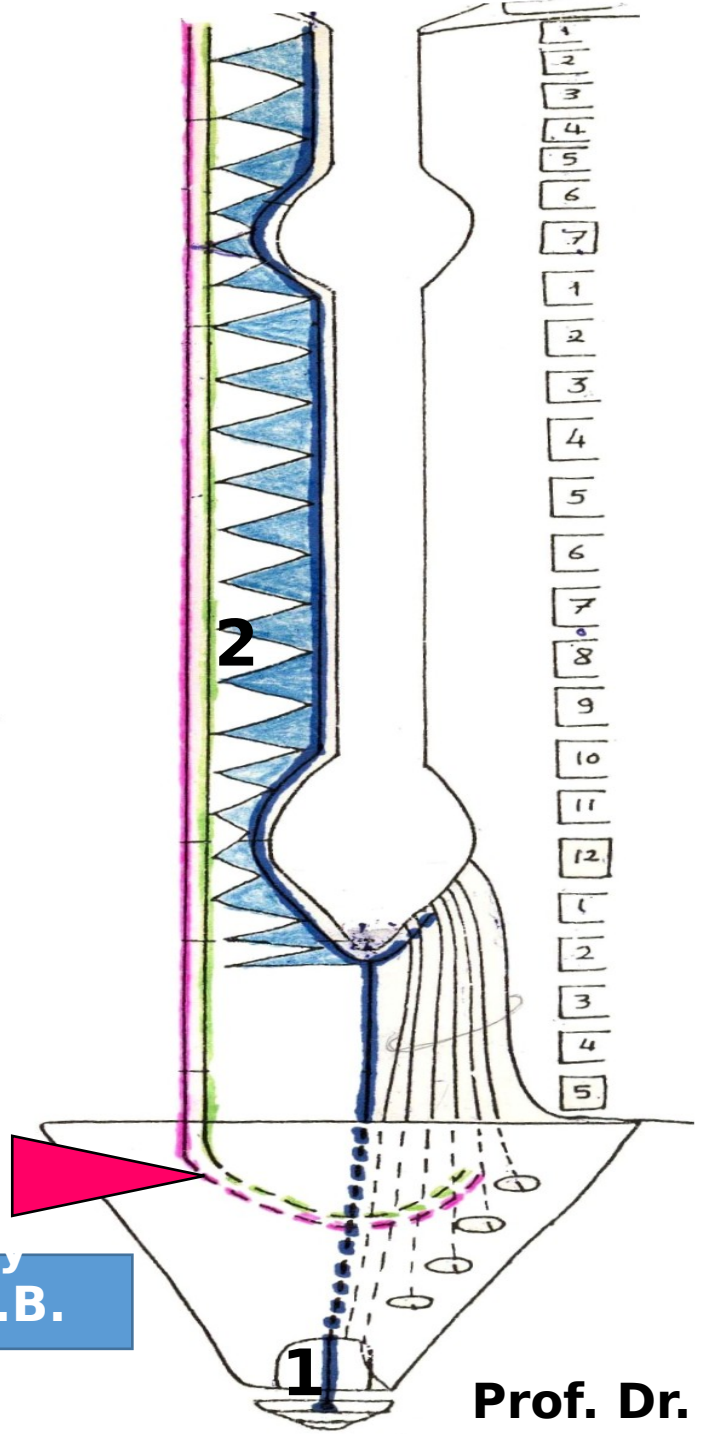
➢ ***Bony attachment of dura*** (attached to S2 piece).

➢ ***3 supporting ligaments traversing the subarachnoid space:***

1)Filum terminale (attached to Cc1 piece).

2)?? Denticulate ligs. (attached to dura).

3)?? Subarachnoid septum



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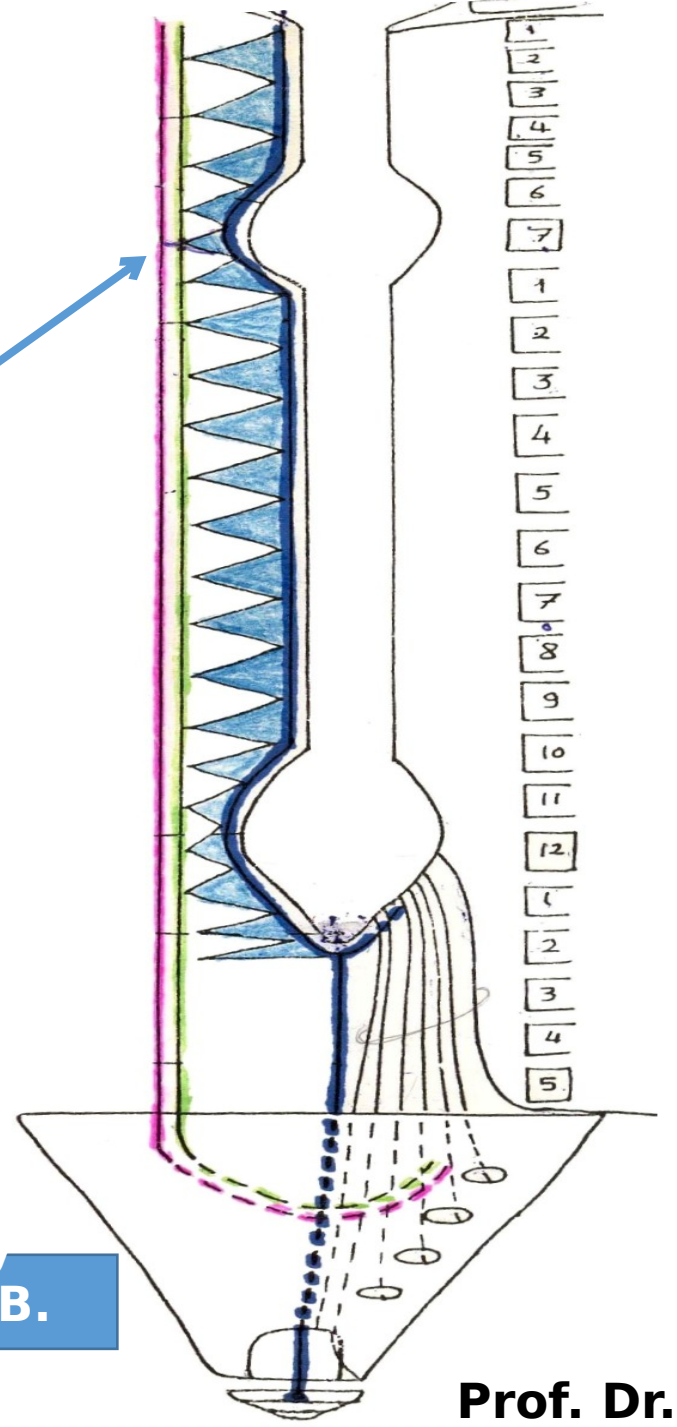
Denticulate ligs.:

a. Serrated triangular ligs.
b. Connect the pia & dura, perforating the arachnoid in water-proof sites.
c. On each side of the spinal cord, between the ventral & dorsal roots **??.**
d. 21 in number.



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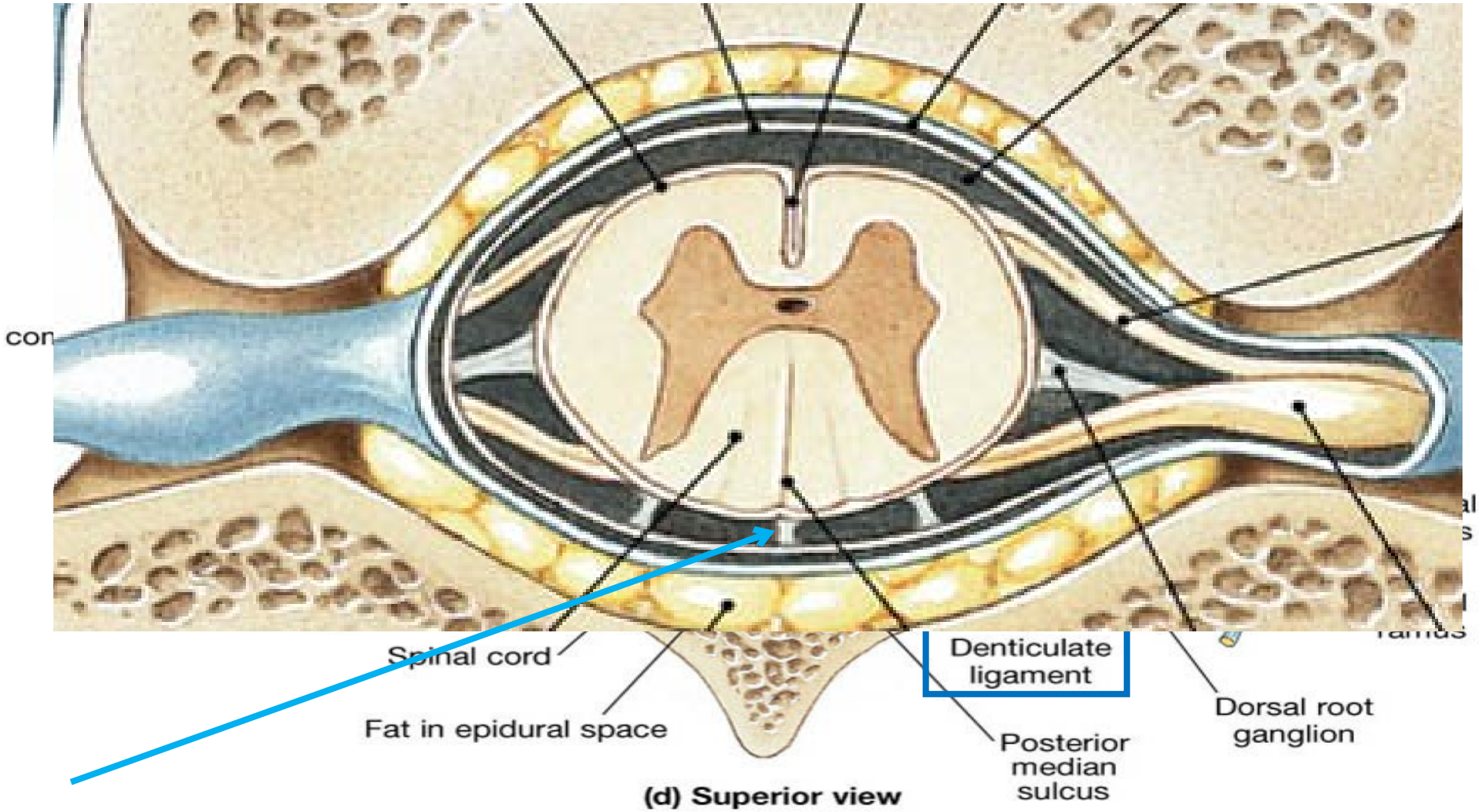
Sub-arachnoid septu

- Is present in the subarachnoid space.
- Extends from the post. median septum to the arachnoid mater.



Lecture Quiz

The arachnoid mater of the spinal cord ends at the level of which of the following vertebrae?

A. L1.
B. L3.
C. S1.
D. S2.
E. Cc1.

Lecture Quiz Answer

The arachnoid mater of the spinal cord ends at the level of which of the following vertebrae?

A. L1.
B. L3.
C. S1.
D. S2.
E. Cc1.

People Say they Love - R A I N -
But When it Rain,
They Use an Umbrella...

People say They Love the - S U N -
But When it Shines,
They Search for Shades...

People say they Love the - W I N D -
But When it Blows,
They Close their Windows...

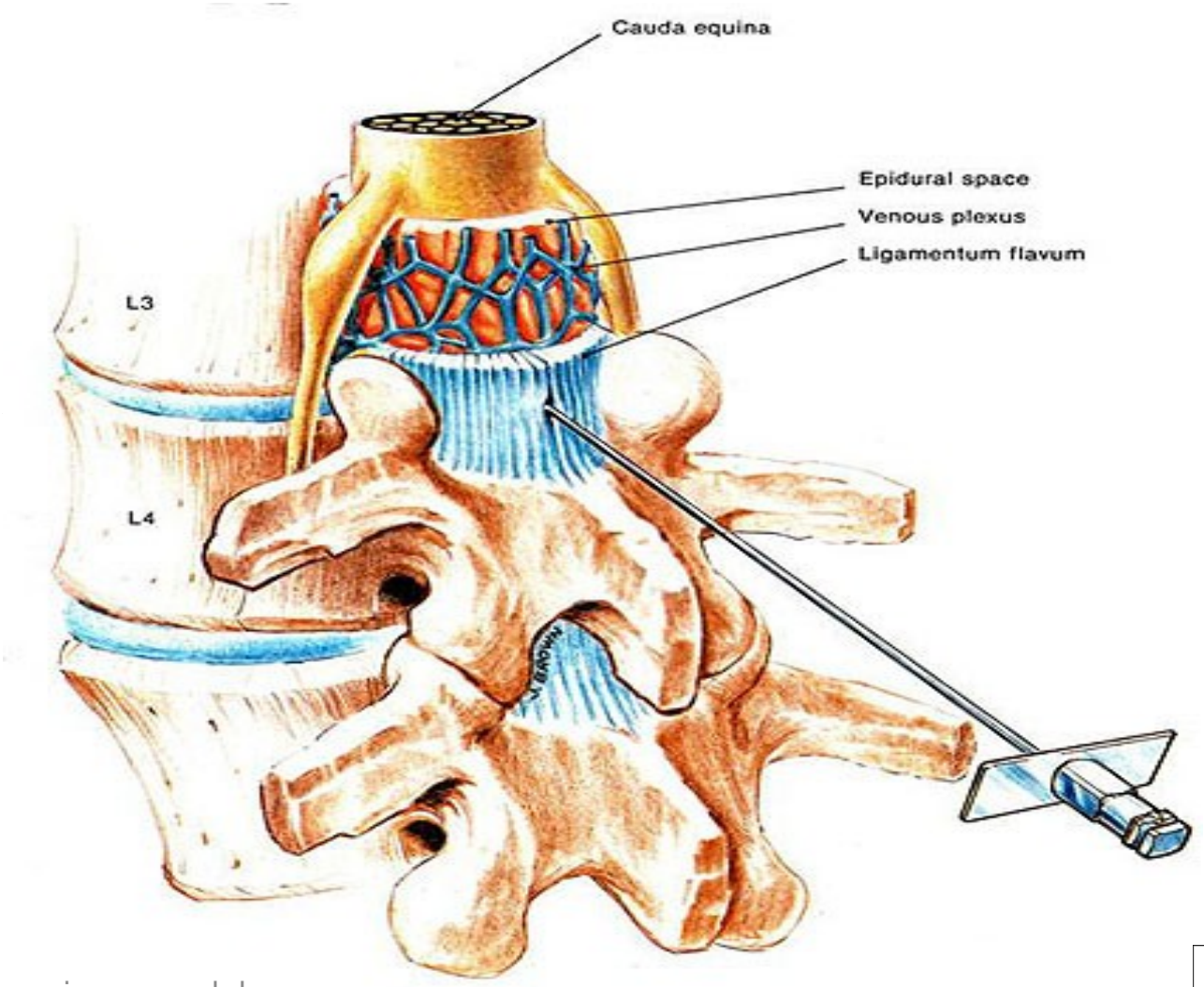
Thats why I just - S M I L E -
When People Say "They Love Me"

C) Lumbar Puncture

Lumbar puncture

- **<u>Technique</u>**:

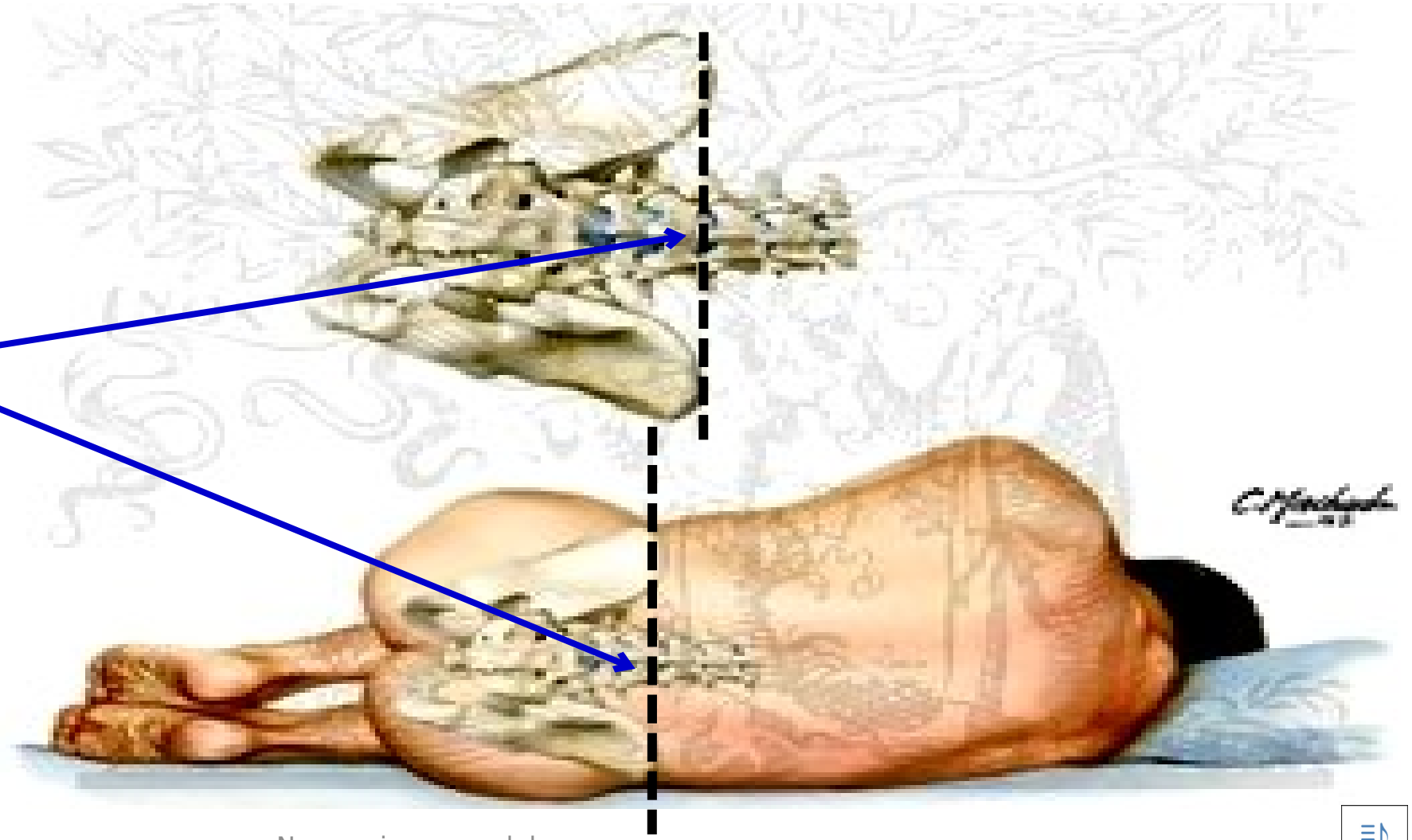
1- A wide-pore needle is inserted exactly in the midline of the back (in the interval bet. the 2 **ligamenta flava**).



Lumbar puncture

- **<u>Technique</u>**:

2- Either below or above tip of **L4 spine** (located at the level of ***highest*** points of iliac crests).



Lumbar puncture

- **Technique:**

3- The following structures ar punctured from superficial t deep:

a. Skin.

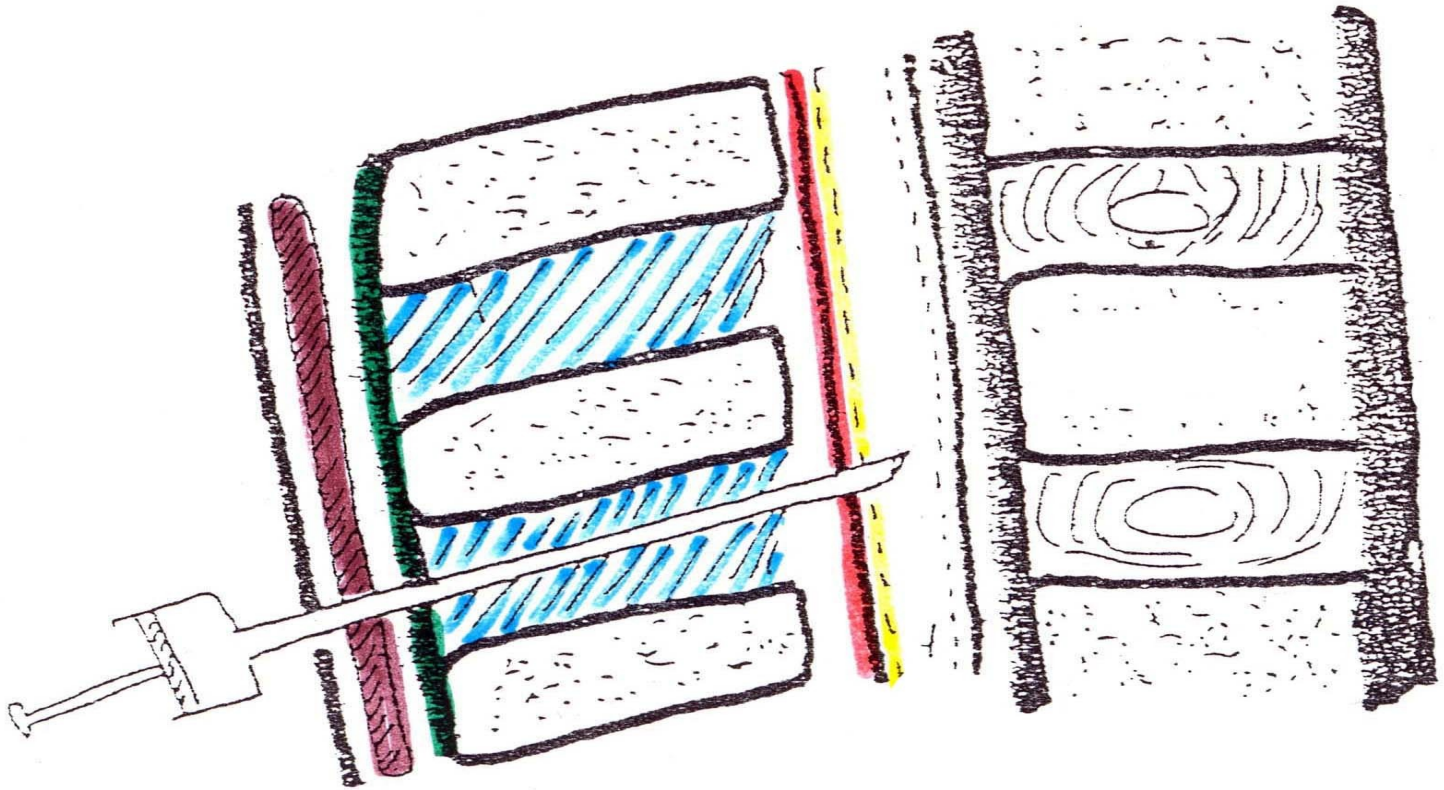
b. Fasciae

c. Supraspinous lig.

d. Interspinous lig.

e. Dura

f. Arachnoid



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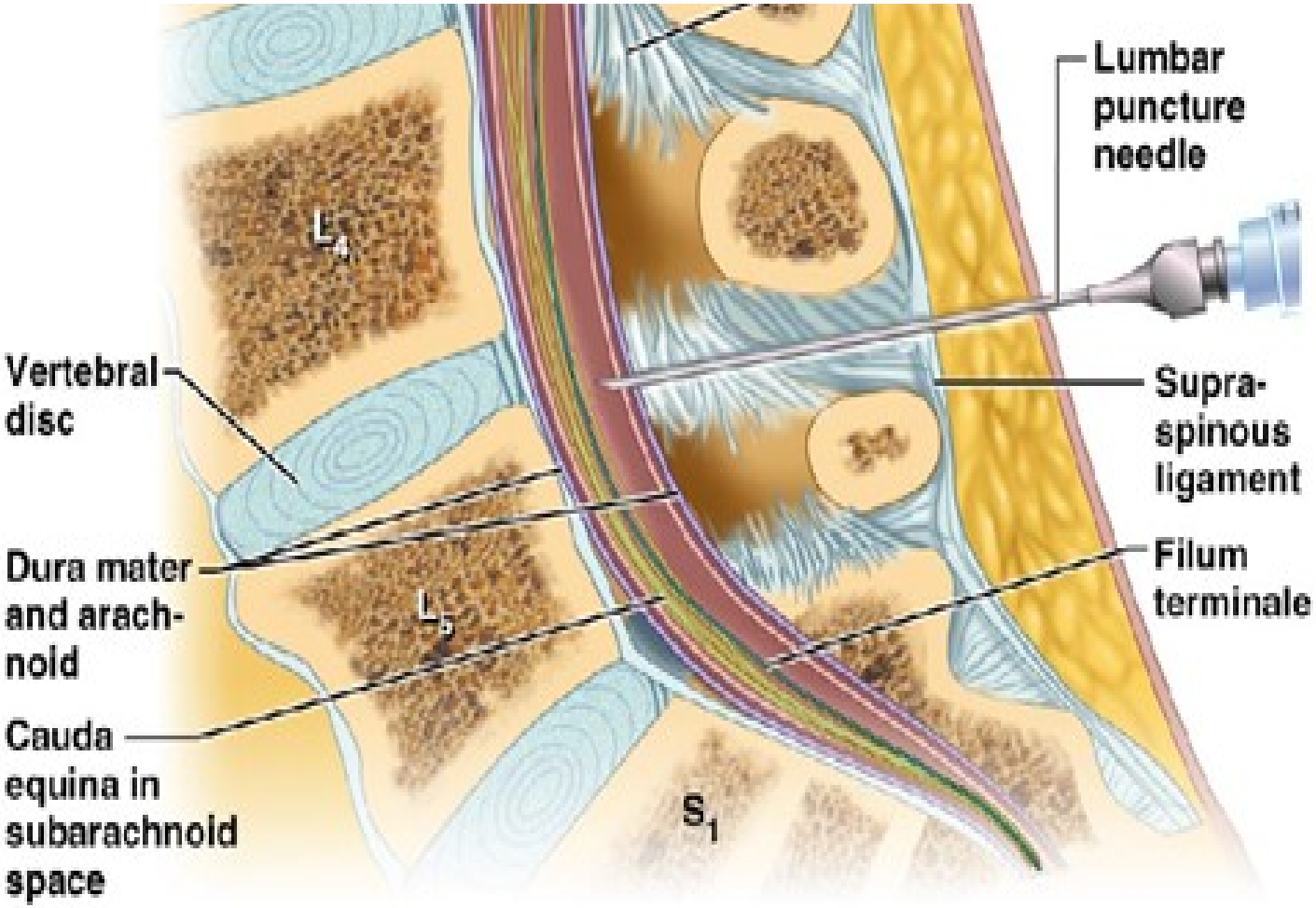
Lumbar puncture



- **Technique:**

3- The following structures are punctured from superficial to deep:

a. Skin.

b. Fasciae

c. Supraspinous lig.

d. Interspinous lig.

e. Dura

f. Arachnoid

Lumbar puncture

Diagnostic purposes

- Obtaining a cerebro-spinal fluid (CSF) sample.
- Measuring CSF pressure (in case of meningitis).
- Injection of air (to do air encephalography … not used nowadays).

Therapeutic purposes

- Removal of CSF (in cases of increased intracranial tension; ↑ ICT).
- Injection of antibiotics (in case of meningitis).
- Injection of local anesthesia (to do spinal anesthesia).

Lecture Quiz

Lumbar puncture is not indicated in which one of the following purposes ?

A. To take a C.S.F. sample.
B. To measure blood pressure.
C. To decrease C.S.F. pressure.
D. To inject antibiotics.
E. To do air encephalography.

Lecture Quiz Answer

Lumbar puncture is not indicated in which one of the following purposes ?

A. To take a C.S.F. sample.

B. To measure blood pressure.

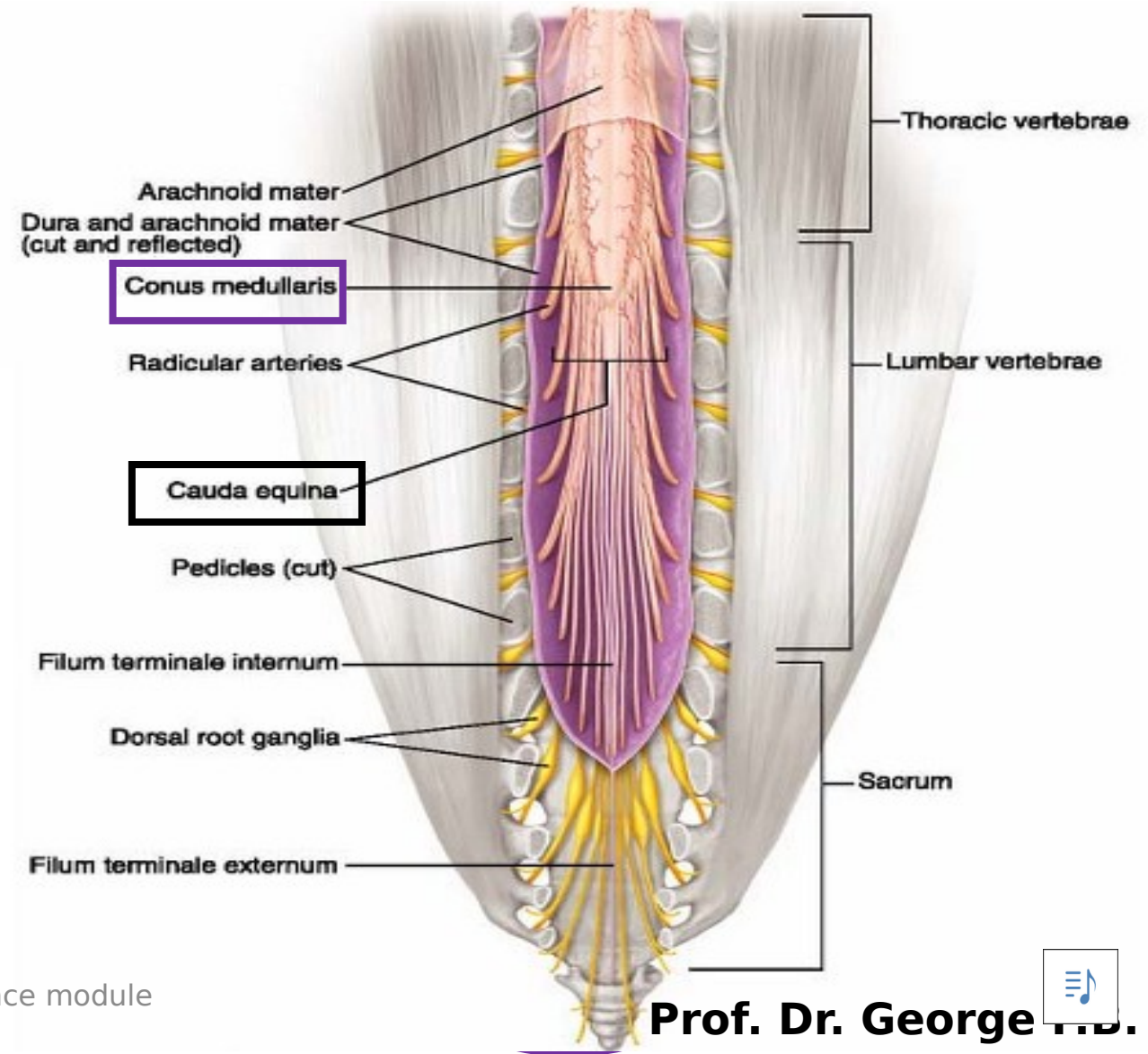
C. To decrease C.S.F. pressure.

D. To inject antibiotics.

E. To do air encephalography.

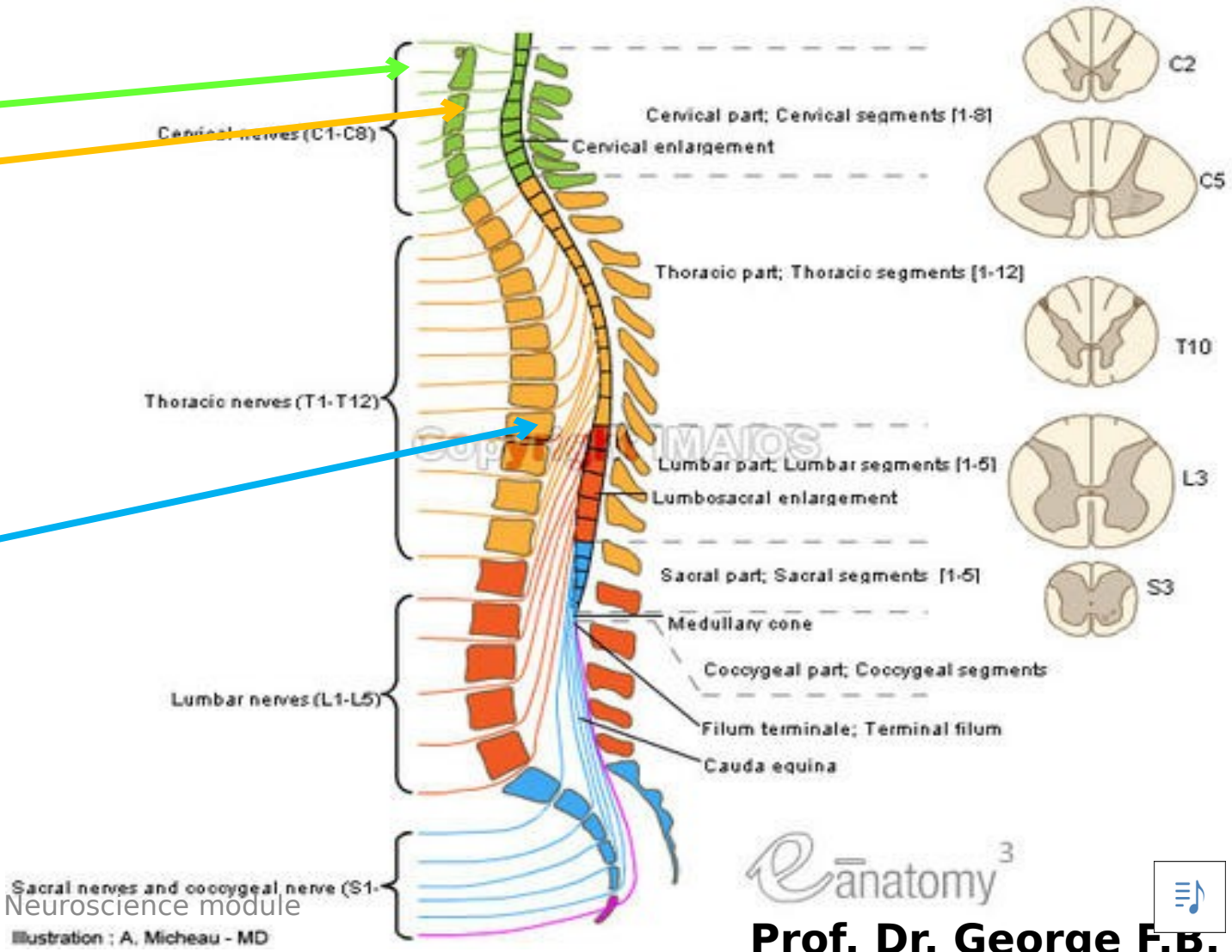
Spinal Ns.: 1- Number & shape

- **31 pairs arranged as follows:** 8**C**, 12**T**, 5**L**, 5**S** & 1 **Cc**.
- Since the spinal cord ends at the lower border of L1, the lower **L.**, **S.** **&** **Cc.** Ns. from a collection of N. fibers below L1 level, on each side of conus medullaris, called **Cauda equina**.



Spinal Ns.: 2- Direction

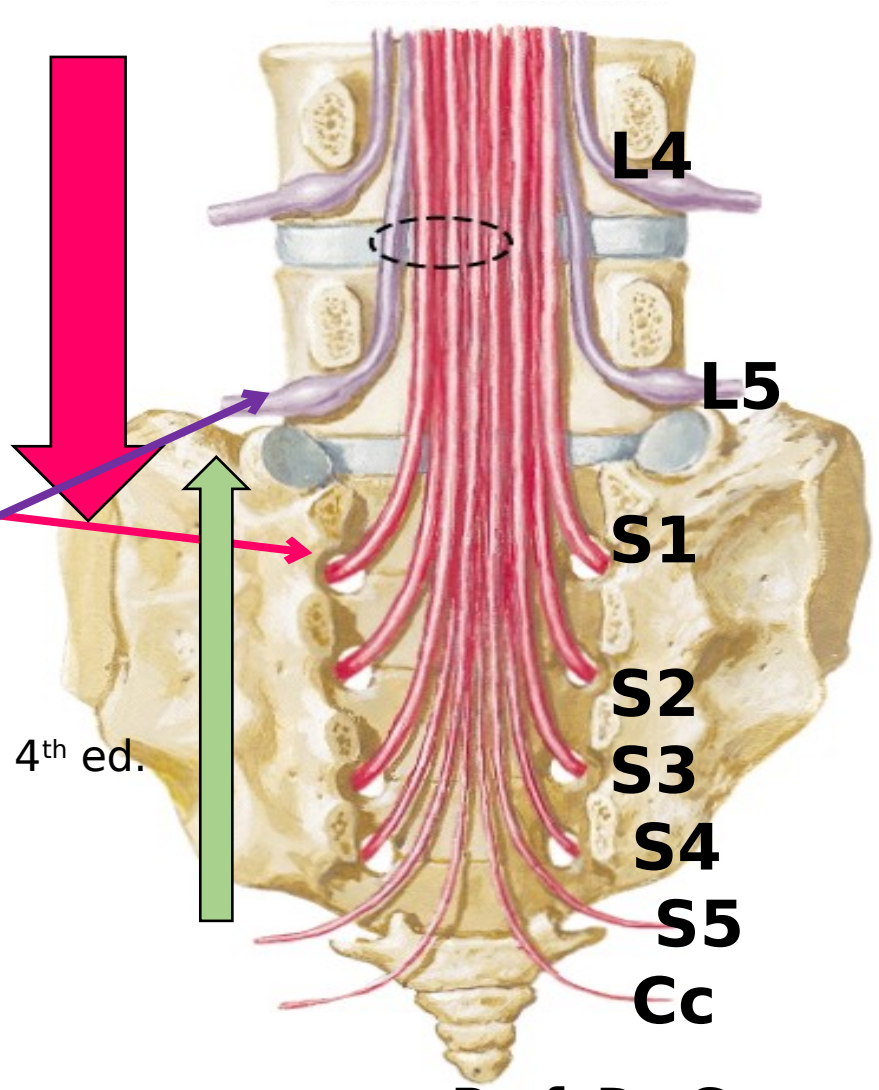
- **C1,2 →** horizontal.
- **C3** till **T12** → oblique *(the obliquity increases as we go caudally).*
- **L1** till **Cc** → vertical



Spinal Ns.: 3- Applied anatomy

NERVE COMPRESSION:

- Since the size of spinal Ns. increases from as we go caudally (the largest of which is **S1**) & the size of inter-vertebral foramina decreases from as we go caudally → **L4 & L5 Ns.** are most liable to compression.



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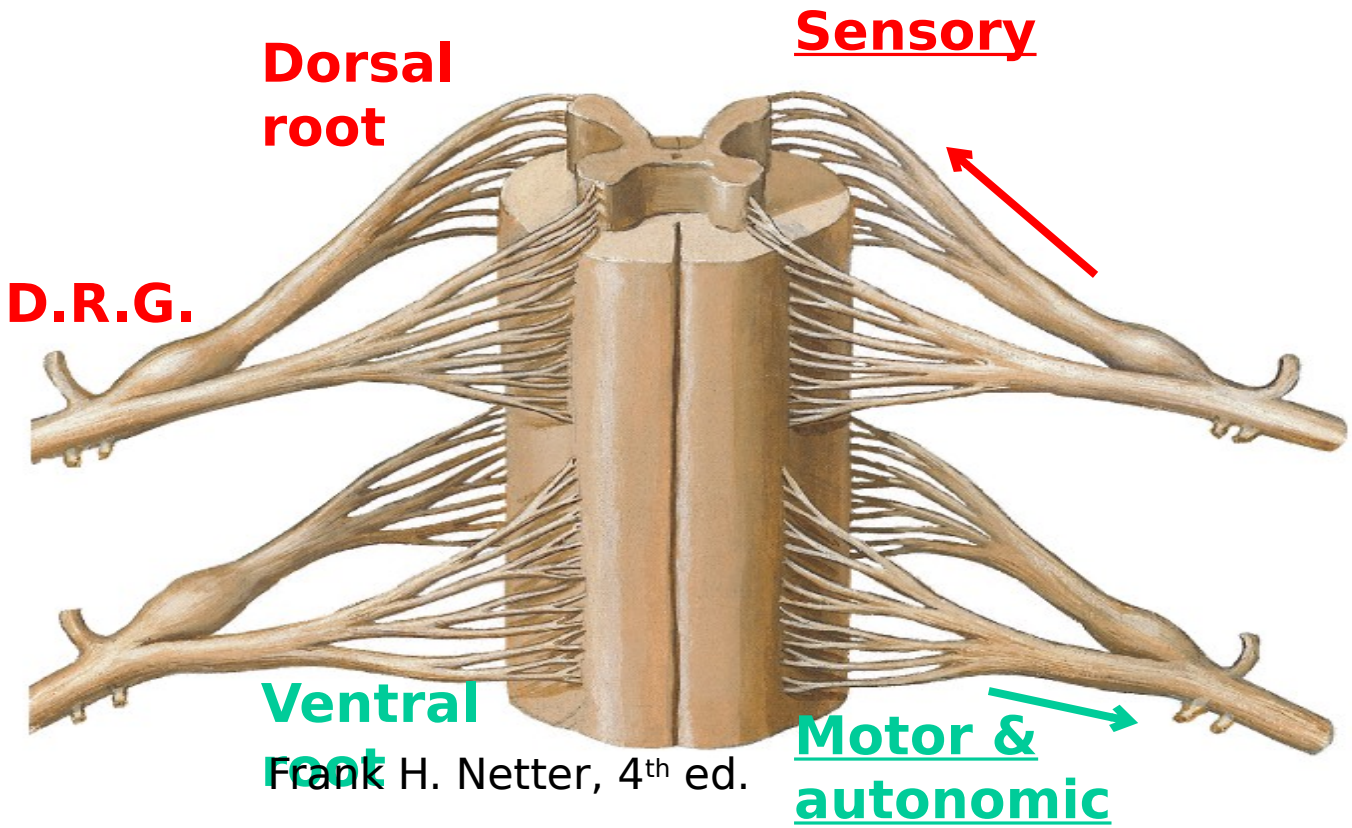
Spinal Ns.: 4- Roots

Origin: by 2 Roots:

Ventral Root	Dorsal Root
Emerges via the anterolat. aspect (sulcus) of the cord.	Emerges via the posterolat. aspect (sulcus) of the cord.
Contains the axons of cells of the ant. + lat. horns.	Contains the axons of cells of the post. horn & D.R.G.
Motor & autonomic in function (without ganglia)	Sensory (with a ganglion called **D**orsal **R**oot **G**anglion = **D.R.G.**)



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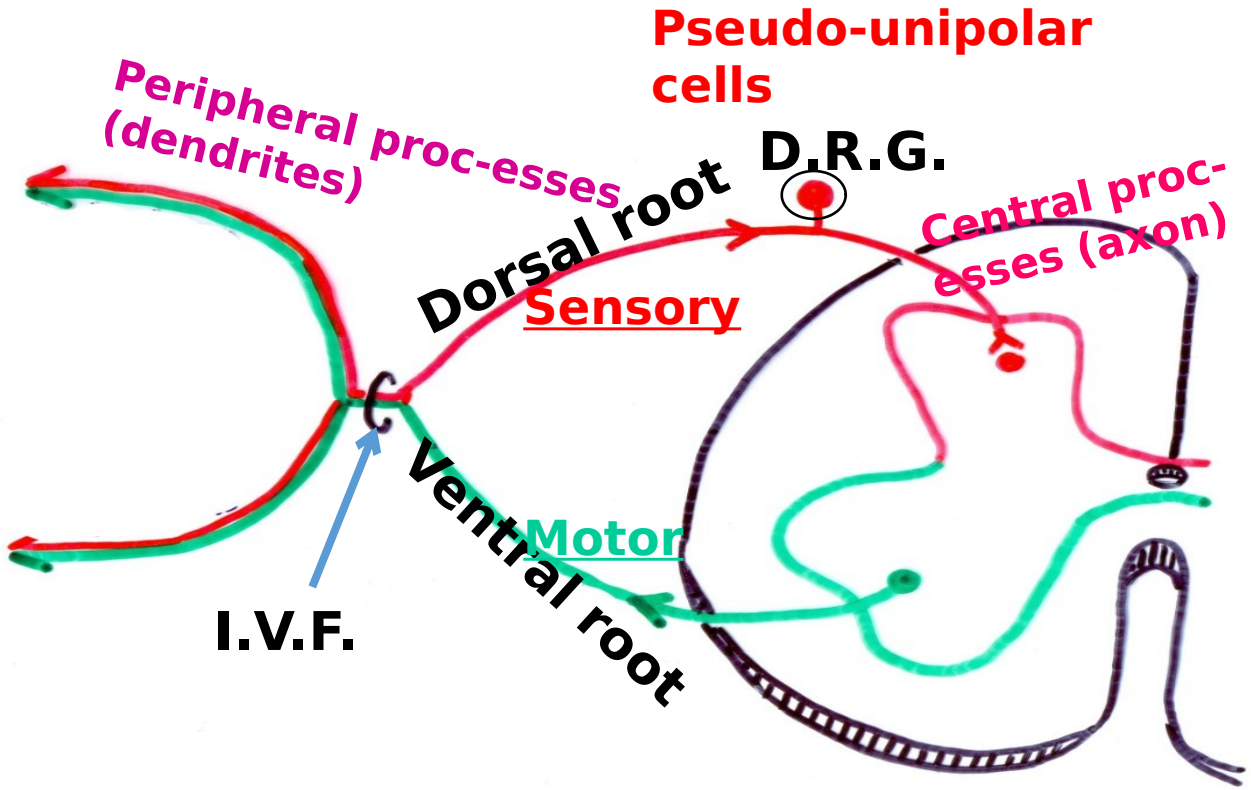
Motor & autonomic in function (without ganglia)	Sensory (with a ganglion called dorsal root ganglion = D.R.G.)



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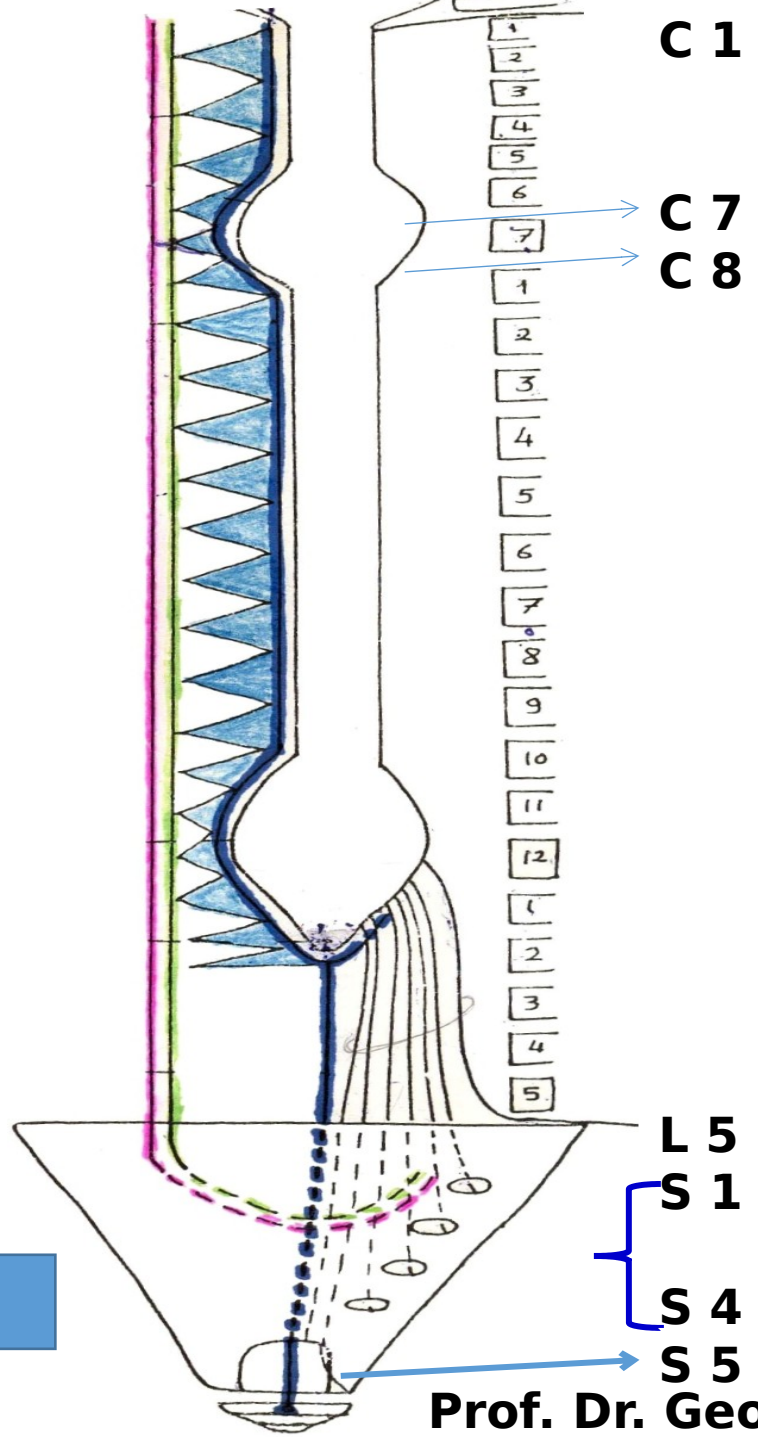
Spinal Ns.: 5- Exit

Each N. leaves the vertebral canal via the inter-vertebral foramen in this way:

C1- 7 Ns.	Above the corresponding vertebra
C8 N.	Below C7 vertebra
T1- L5	Below the corresponding vertebra
S1- S4 Ns.	Divide into ant. & post. divisions that pass through ant. & post. sacral foramina
S5 & Cc Ns.	Through sacral hiatus



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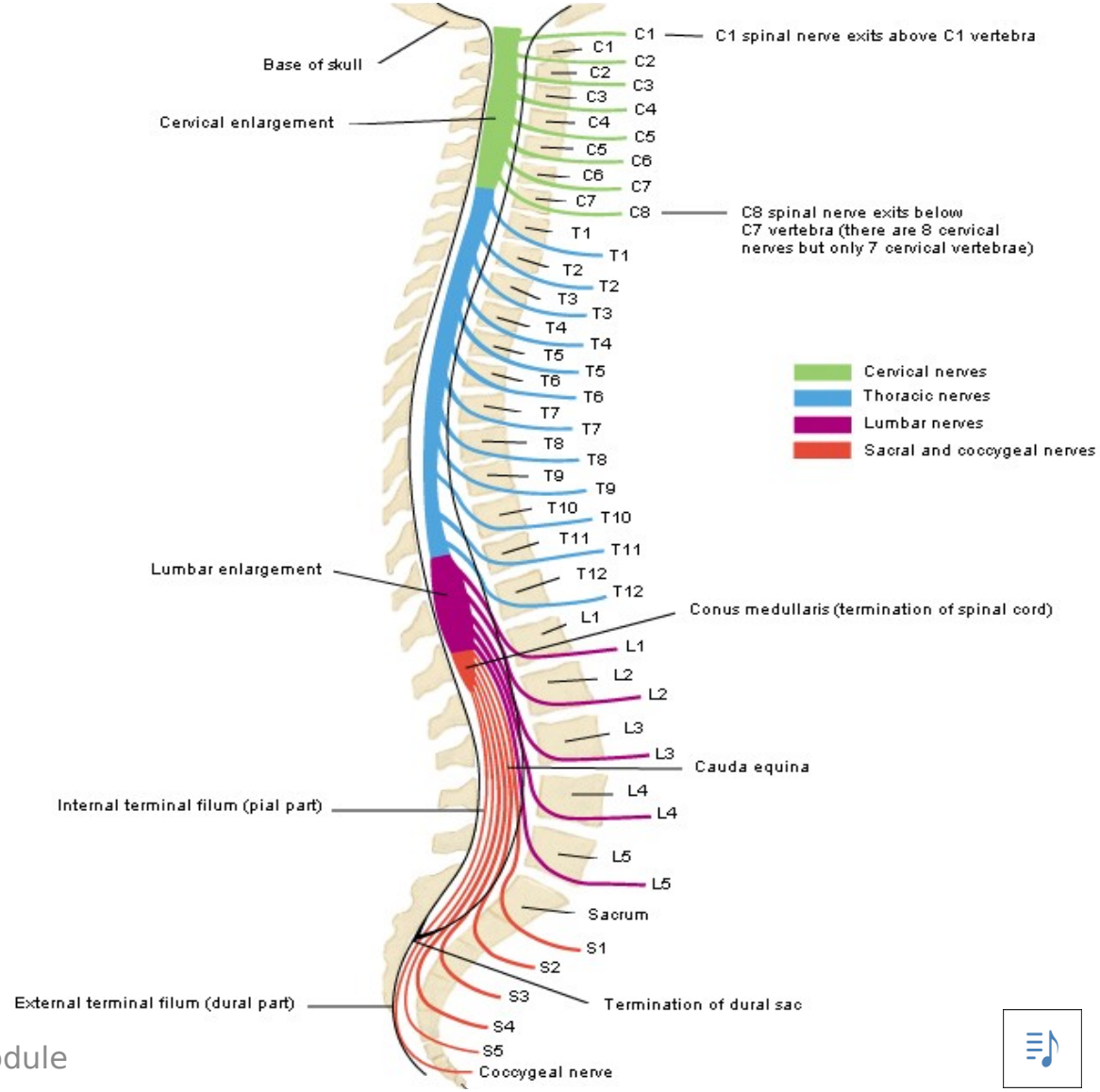
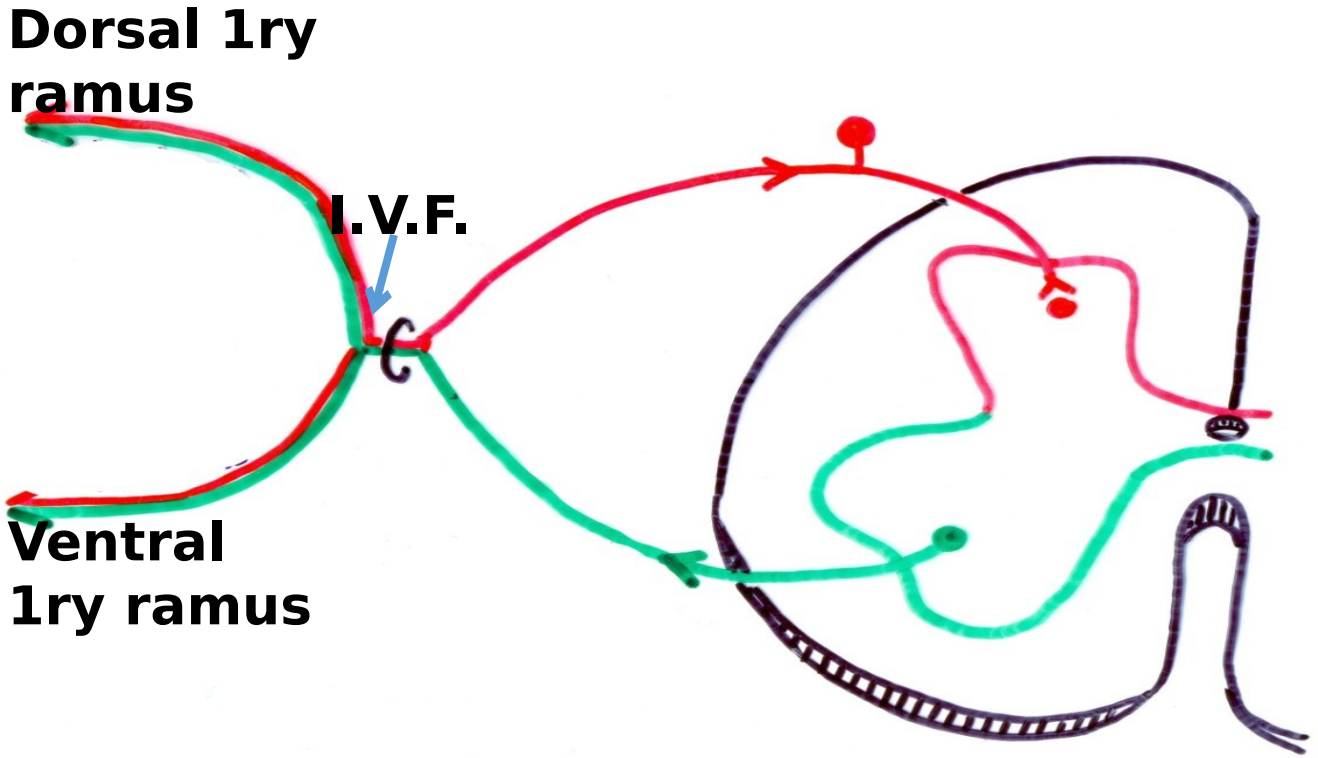


Spinal Ns.: 6- Rami (Branches)

- ***Termination:*** by 2 branches = 2 1ry rami

Ventral	Dorsal
1- Larger	1- Smaller
2- Tend to form plexuses except in thorax where prevented by ribs.	2- Do NOT tend to form plexuses.
3- Supply skin & Ms. of anterolat. aspect of trunk	3- Supply skin & Ms. of back of trunk as far as the mid-axillary line.
4- Supply skin & Ms. of limbs.	4- Supply skin & Ms. of neck.



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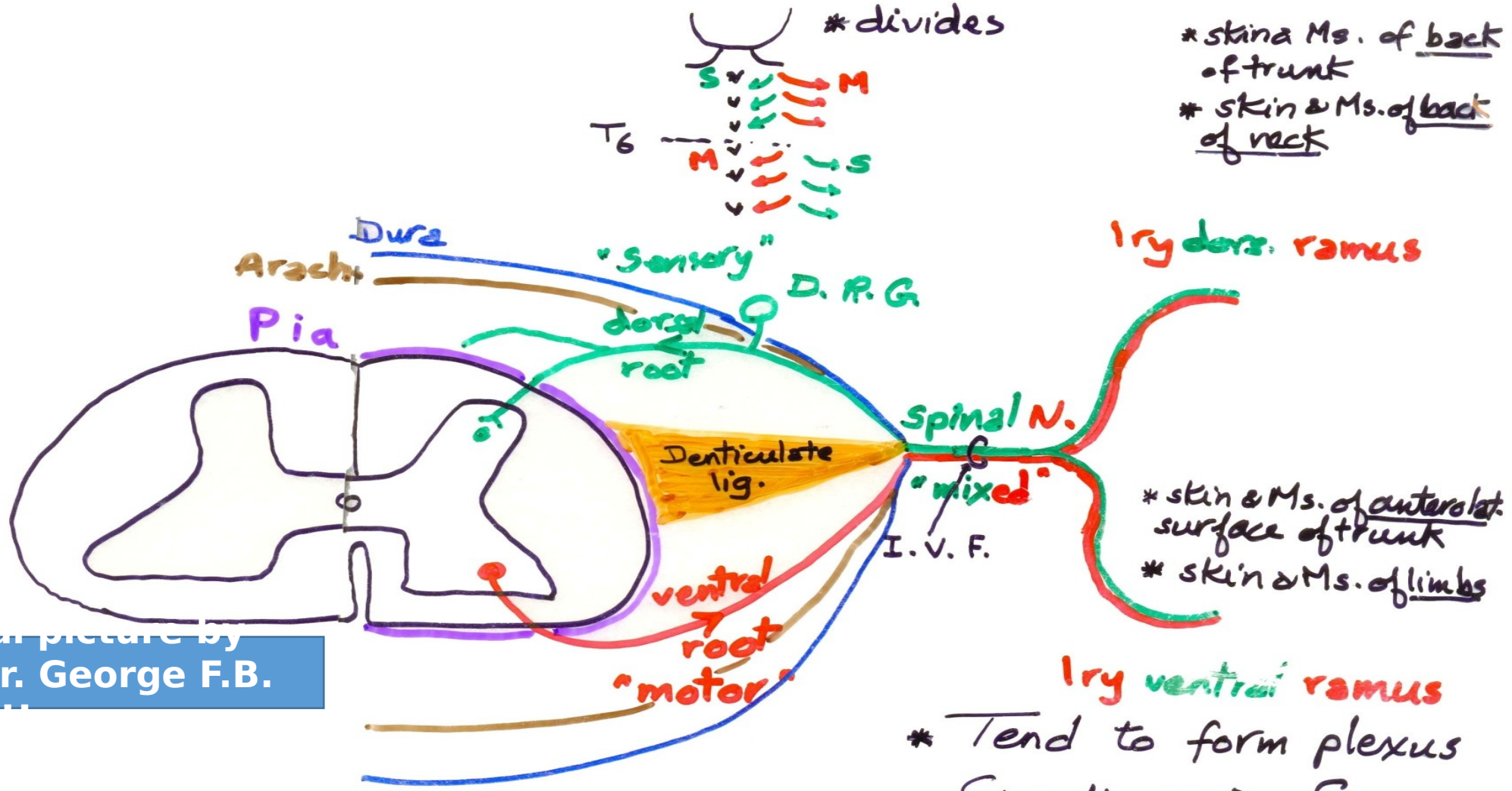

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LET'S REVISE

Relation between vertebrae & spinal cord segme

C. vertebrae

- Add 1
- e.g. C3 vertebra → C4 segment.

T 1-6 vertebrae

- Add 2
- e.g. T3 vertebra → T5 segment.

T 7-10 vertebrae

- Add 3
- e.g. T7 vertebra → T10 segment.

Relation between vertebrae & spinal cord segme

T 11 vertebra

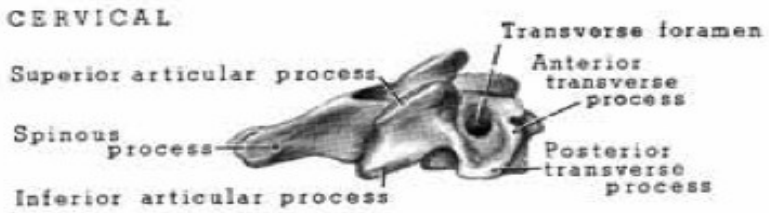
- Add 4
- i.e. T11 vertebra → L3 segment.

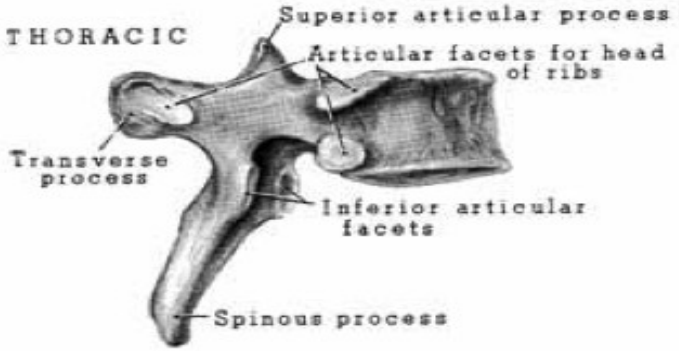
T 12 vertebra

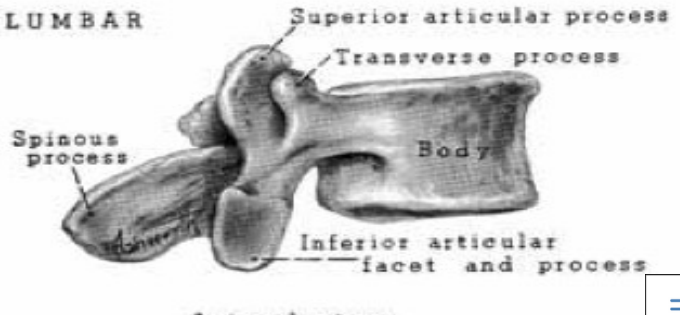
- Add 6
- i.e. T12 vertebra → S1 segment.

L 1 vertebra

- Where spinal cord ends
- Rest of segments → S2-Cc segm







Marital statusالحالة الاجتماعية

Spinal cord: T.S. Structure

2 halves:

- **Enclosing in its center:** the **Central canal*:**
  1. Is continuous above with that of medulla oblongata.
  2. Ends below in conus medullaris by a slight dilatation called **Terminal ventricle**.
- **Separated by:**

1- Post. median septum

2- Ant. median fissure

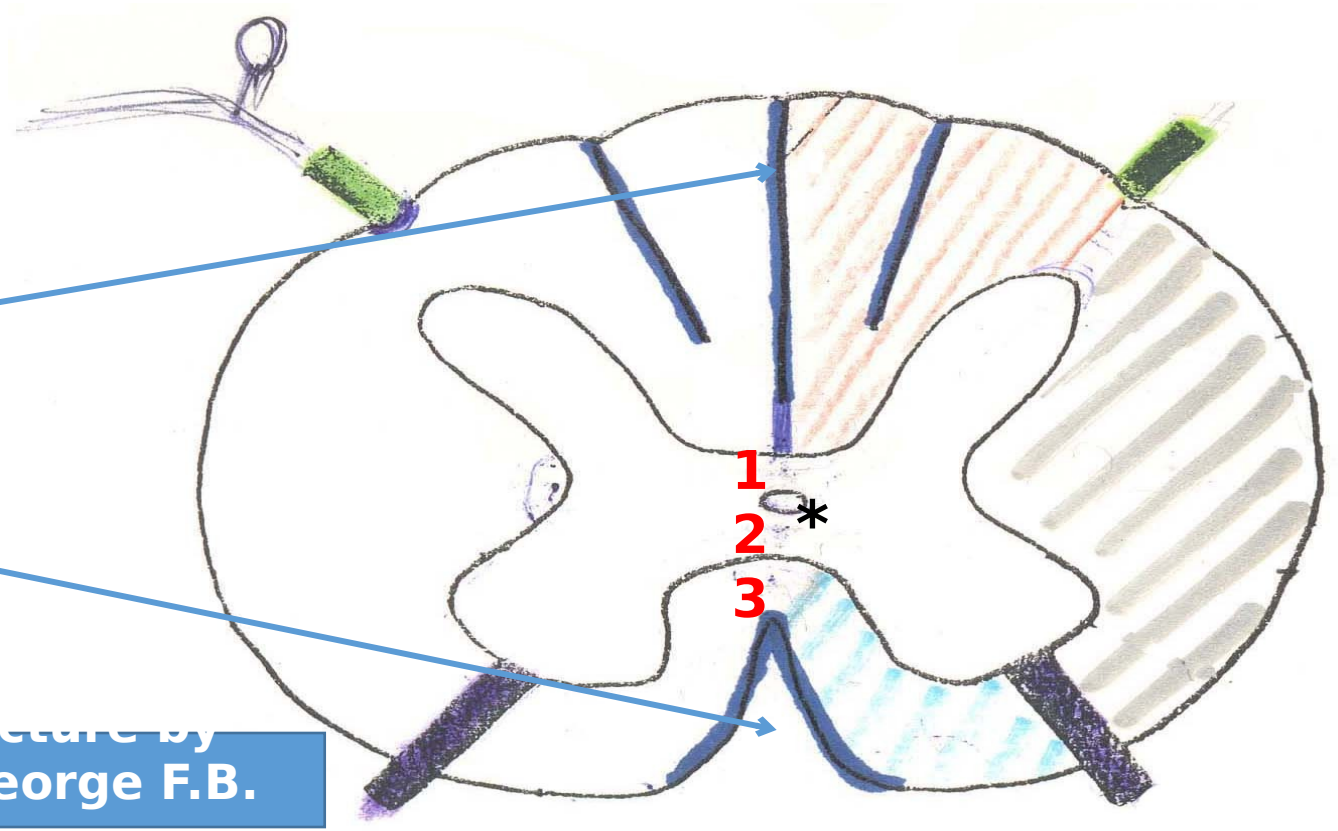
- **Connected by:**

3 commissures:

1- Post. Grey commissure.

2- Ant. Grey commissure.

3-Ant. White commissure.



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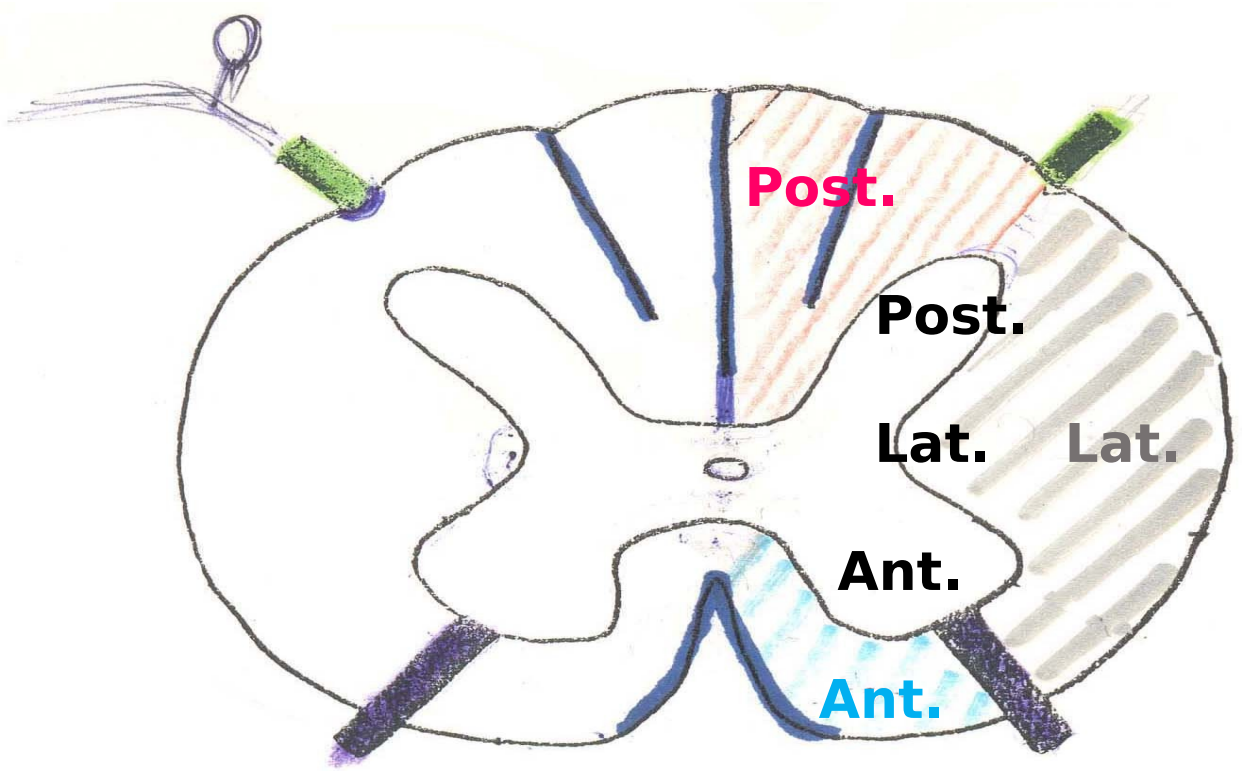
Internal structure of each half



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Grey matter

- **N. somata (nuclei)** + blood vessels & neuroglia
- **3 horns** (ant., post. ± lat.)

White matter

- **N. Fibers (tracts)** + blood vessels & neuroglia
- **3 columns** (**ant.** **post.** + **lat.**)

Tracts of the White matter

- ***3 columns:***

1- Ant. (bet. ant. median fissure to exit zone of the ventral root)

2- Lat. (bet. entry zone of dorsal root & exit zone of the ventral root)

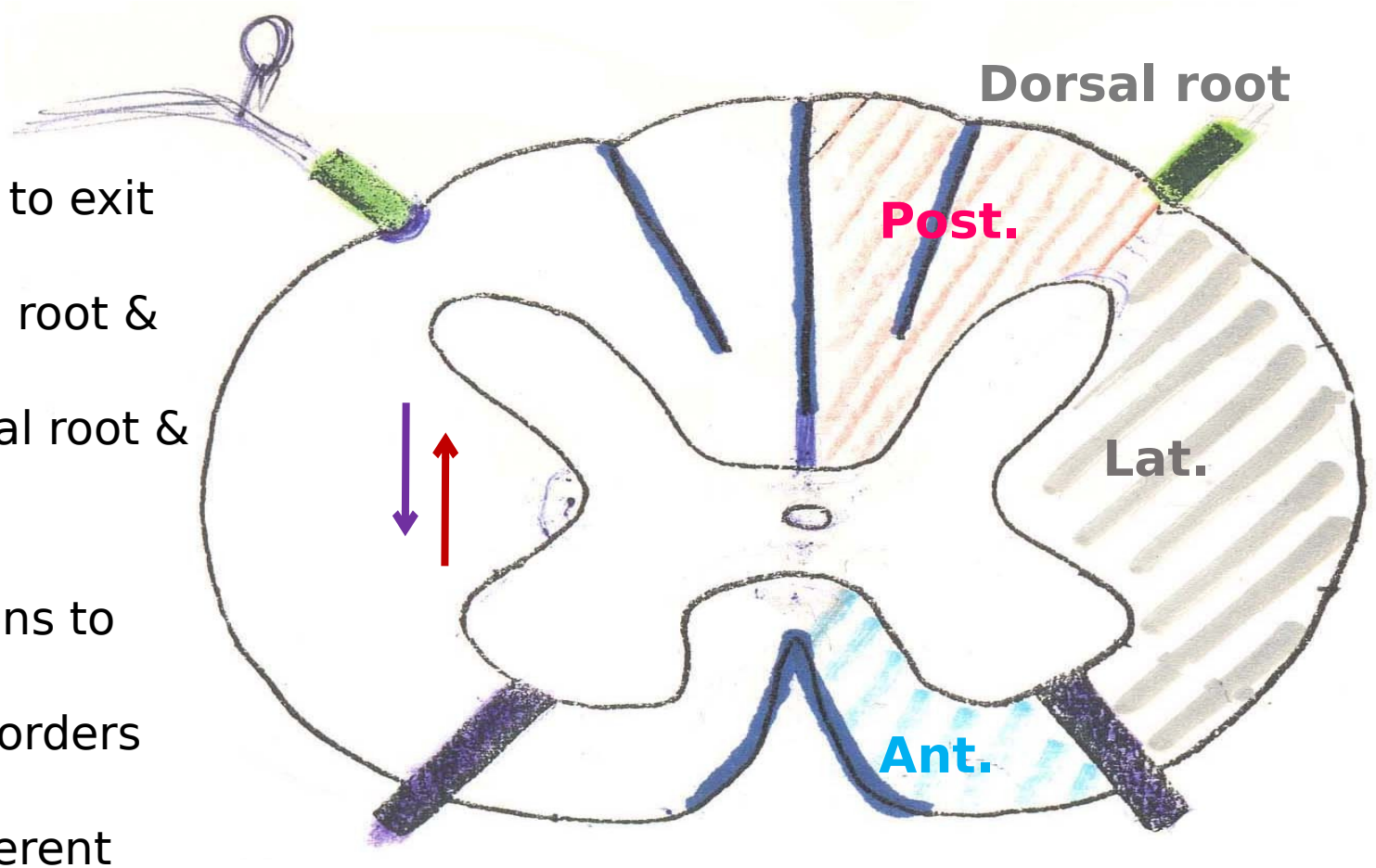
3- Post. (bet. entry zone of dorsal root & post. median septum).

- ***3 types:***

1- Ascending (carrying sensations to higher centers).

2- Descending (carrying motor orders from higher centers).

3- Associative (connecting different segments of the spinal cord).



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Lecture Quiz

A patient is suffering from a lesion in the fifth cervical segment of the spinal cord; fracture dislocation of which of the following vertebra is most likely causing the lesion?

a)C3

b)C4

c)C5

d)C6

e)C7

Lecture Quiz Answer

A patient is suffering from a lesion in the fifth cervical segment of the spinal cord; fracture dislocation of which of the following vertebra is most likely causing the lesion?

a)C3

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e)C7

Summary ثـــلاثات

- **3 parts of the brain (fore-, mid- & hind).**
- **3 components of the hindbrain (pons, medulla & cerebellum).**
- **3 parts of the brain stem (midbrain, pons & medulla).**
- **3 levels of spinal cord termination according to age (3rd IU month, at birth, adults).**
- **3 exceptions of the cylinderical shape of the spinal cord (cervical enlargement, lumbar enlargement & conus medullaris).**
- **3 meninges (dura, arachnoid & pia), separated by 3 spaces (extradural, subdural & subarachnoid).**
- **3 ligaments traversing the subarchnoid space & supporting the spinal cord (filum terminale, denticulate lig. & subarachnoid septum).**
- **3 steps in the technique of lumbar puncture (bet. lig. flava, at L4 & 6 structures pierced by the needle).**
- **3 diagnostic & 3 therapeutic purposes for which lumbar puncture may be done.**

THANK YOU